Mass CREST

MASSACHUSETTS CENTER FOR RENEWABLE ENERGY SCIENCE AND TECHNOLOGY

"Fuels for the Future"

A Mass-CREST

Energy Research Group

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The Initiative

- **Mass-CREST Mission**

  To enhance the performance of renewable energy devices and systems by ten-fold within the next ten years

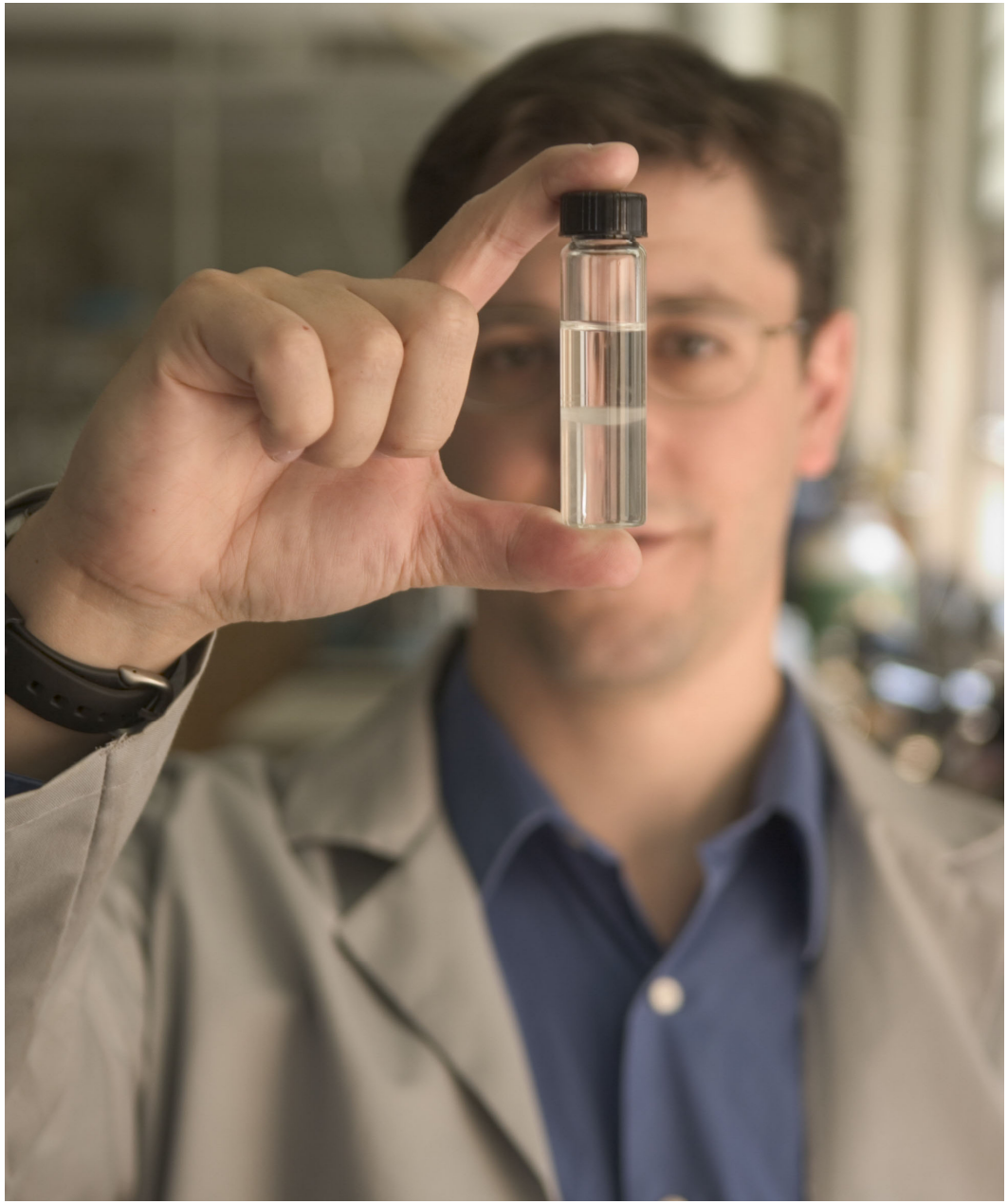
- **Energy Research Groups (ERGs)**
  - Photovoltaics (solar fuels)
  - Fuel cells and batteries
  - Fuels for the Future (cellulosic ethanol, bioalkanes, H_2)

Fuels for the Future - ERG

Mass-CREST takes a multi-pronged approach to solving the biomass-to-fuel conversion problem.

- **Chemical approaches**– development of novel biomass conversion catalysts:
  - Zeolite catalysts
  - Oxide catalysts
- **Biological approaches**

Fuels for the Future - ERG



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Fuels for the Future - ERG

Mass-CREST takes a multi-pronged approach to solving the biomass-to-fuel conversion problem.

- **Chemical approaches** – development of novel biomass conversion catalysts
  - Oxide catalysts
  - Zeolite catalysts
- **Biological approaches**
  - Combining research in plant and microbial biology to devise systems and processes for cellulosic ethanol production

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Cellulosic Ethanol Technology

Consolidated Bioprocessing of Biomass to Ethanol by *Clostridium phytofermentans*

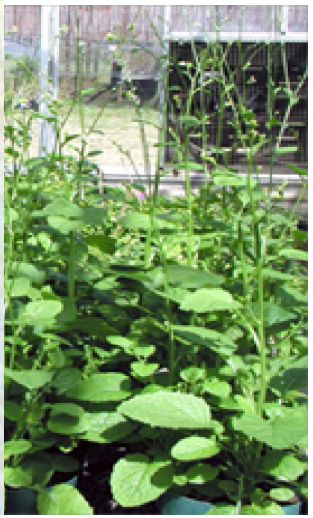
- A technology for the production of **cellulosic ethanol** utilizing a novel bacterium with unique properties

Cellulosic Ethanol Technology

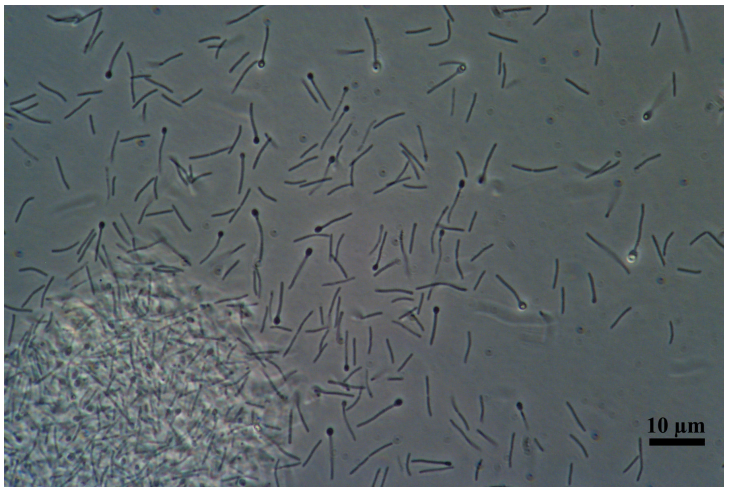
The Technology

Consolidated Bioprocessing of Biomass

- single-step biomass-to-ethanol process
- simple, effective strategy to overcome the recalcitrance of cellulosic biomass
- novel bacterium *Clostridium phytofermentans:*



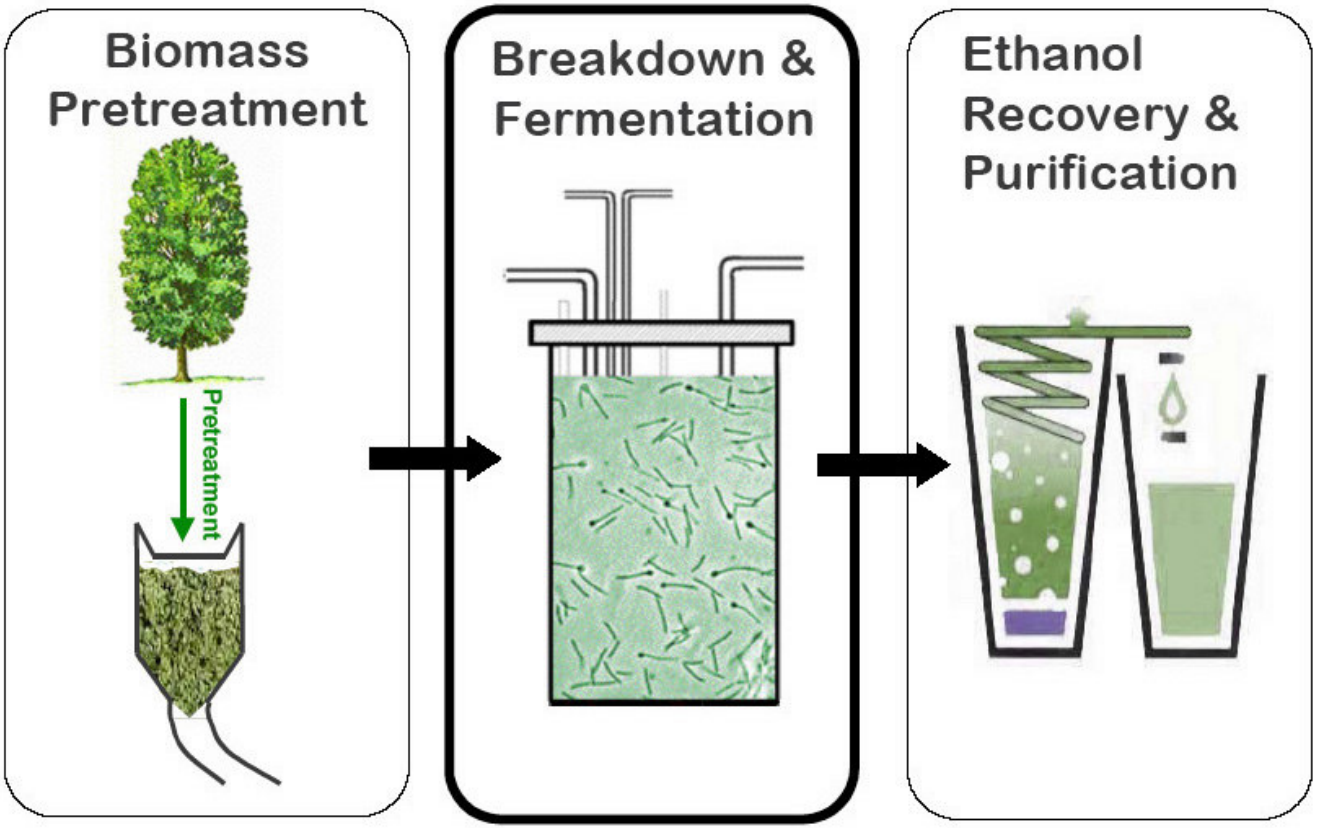
C-phy →



Cellulosic Ethanol Technology

The Technology

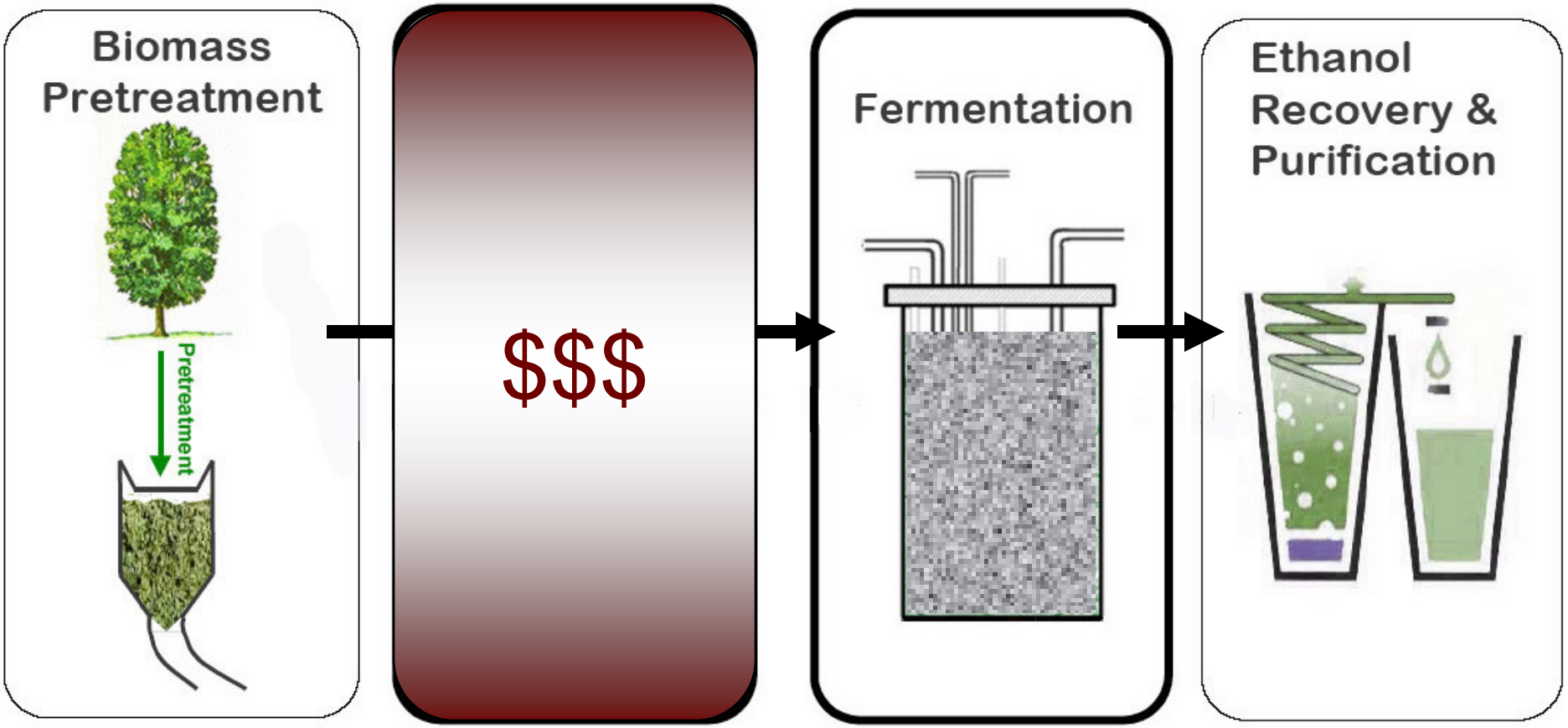
Consolidated Bioprocessing of Biomass



- Cellulase enzyme production, cellulose breakdown, and fermentation are consolidated in a single step in a bioreactor

Cellulosic Ethanol Technology

Existing Technology

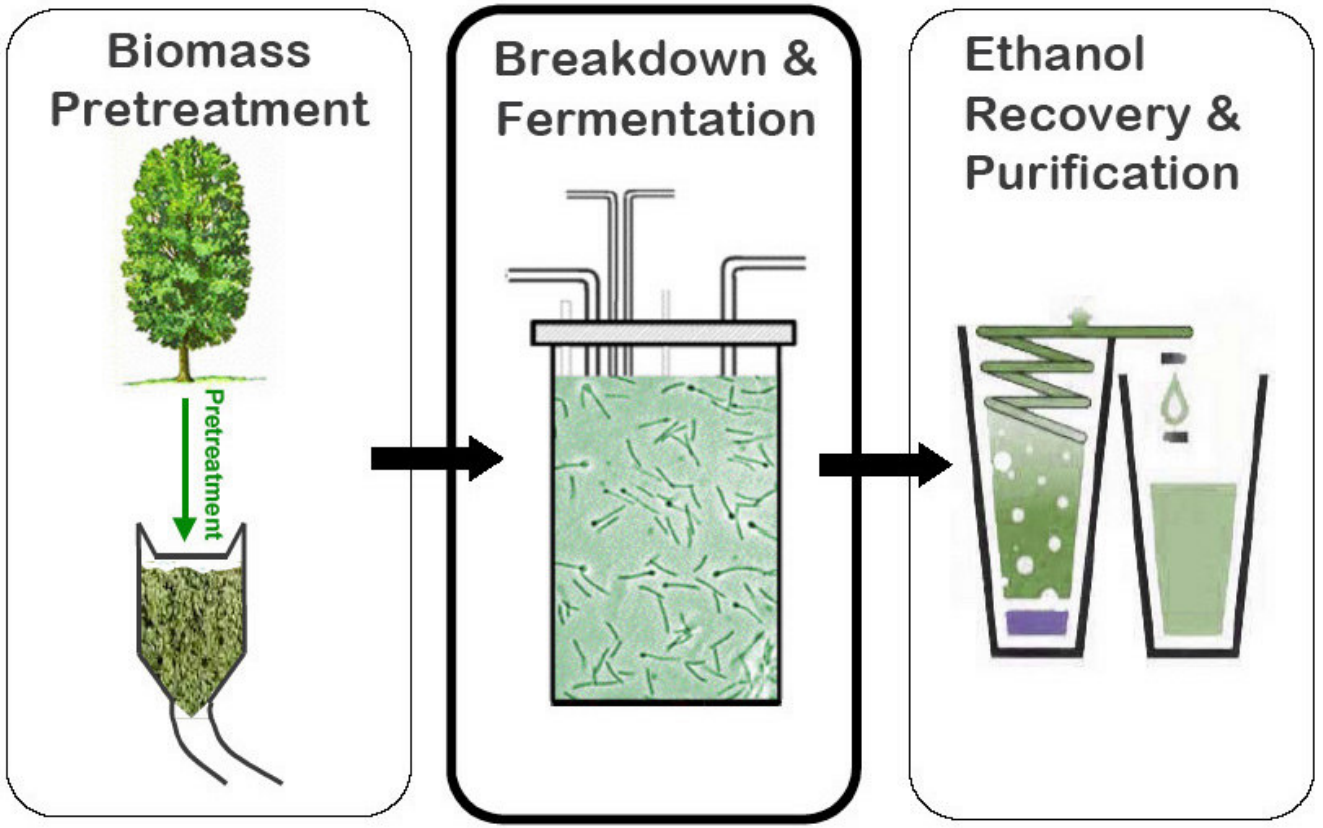


- Current cellulosic ethanol processes requires **enzymes $$$**

Cellulosic Ethanol Technology

Our Technology

Consolidated Bioprocessing of Biomass



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Cellulosic Ethanol Technology

How does our C-phy CBP technology compare?

Our process:

- **single-step biomass-to-ethanol process**
  - ✓ ***Reduced complexity***
- **process incorporates enzyme production**
  - ✓ ***Separate enzyme production unnecessary***

Impediments to commercializing existing technologies:

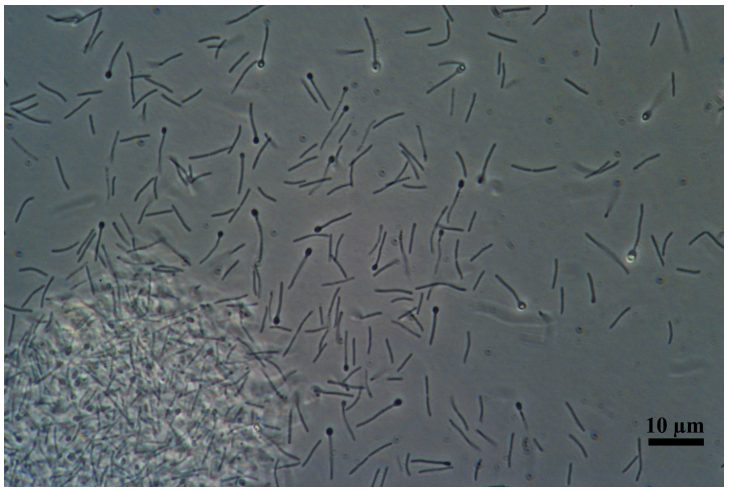
- ✓ ***Process complexity***
- ✓ ***Enzymes are expensive!***

Cellulosic Ethanol Technology

Unique properties of C-phy make this technology possible

- simultaneously ferments multiple different components of biomass
- ferments unusually high concentrations of cellulose
- high ratio of ethanol to other products

C-phy →

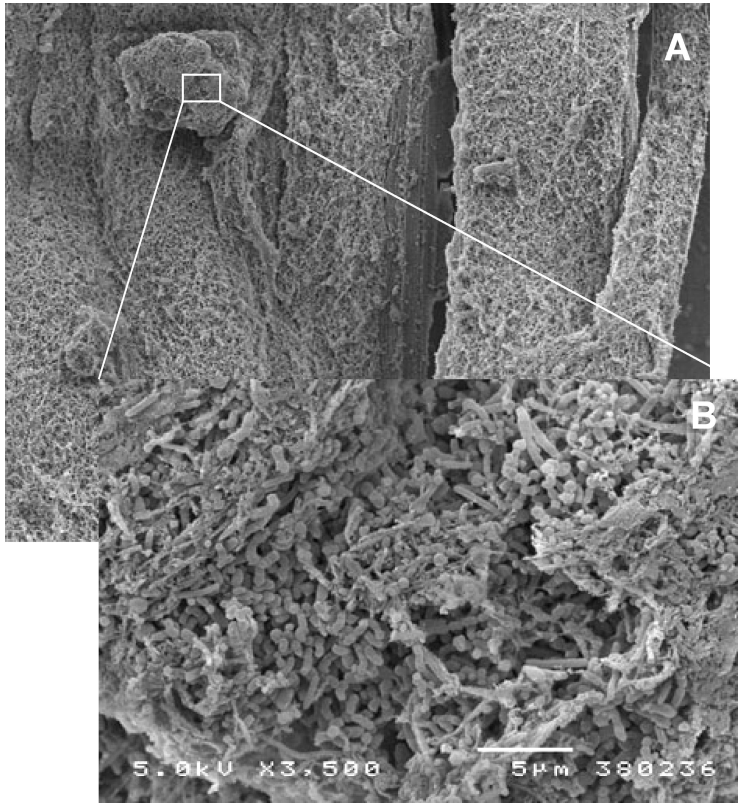


Cellulosic Ethanol Technology

Unique properties of C-phy make this technology possible

Cellulose ↓ Ethanol

SunEthanol



C-phy → growing on cellulose

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Thank you!